

US009276424B2

(12) **United States Patent**  
**Paczkowski et al.**

(10) **Patent No.:** **US 9,276,424 B2**  
(45) **Date of Patent:** **Mar. 1, 2016**

(54) **ADAPTER FOR FOLDABLE BATTERY CHARGER**

(71) Applicant: **Bren-Tronics, Inc.**, Commack, NY (US)

(72) Inventors: **Henry Paczkowski**, Manhasset Hills, NY (US); **Daniel Sha**, Farmingdale, NY (US); **Peter J. Burke**, East Northport, NY (US); **Sai Fung**, Melville, NY (US)

(73) Assignee: **Bren-Tronics, Inc.**, Commack, NY (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 89 days.

(21) Appl. No.: **14/156,147**

(22) Filed: **Jan. 15, 2014**

(65) **Prior Publication Data**

US 2014/0132205 A1 May 15, 2014

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 13/927,447, filed on Jun. 26, 2013.

(60) Provisional application No. 61/664,868, filed on Jun. 27, 2012.

(51) **Int. Cl.**  
**H02J 7/00** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **H02J 7/0045** (2013.01); **H02J 7/0042** (2013.01)

(58) **Field of Classification Search**  
USPC ..... 320/107  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,919,615 A	11/1975	Niecke	
5,295,089 A	3/1994	Ambasz	
5,601,942 A	2/1997	Fedele	
2005/0052156 A1	3/2005	Liebenow	
2011/0227527 A1*	9/2011	Zhu et al.	320/108

\* cited by examiner

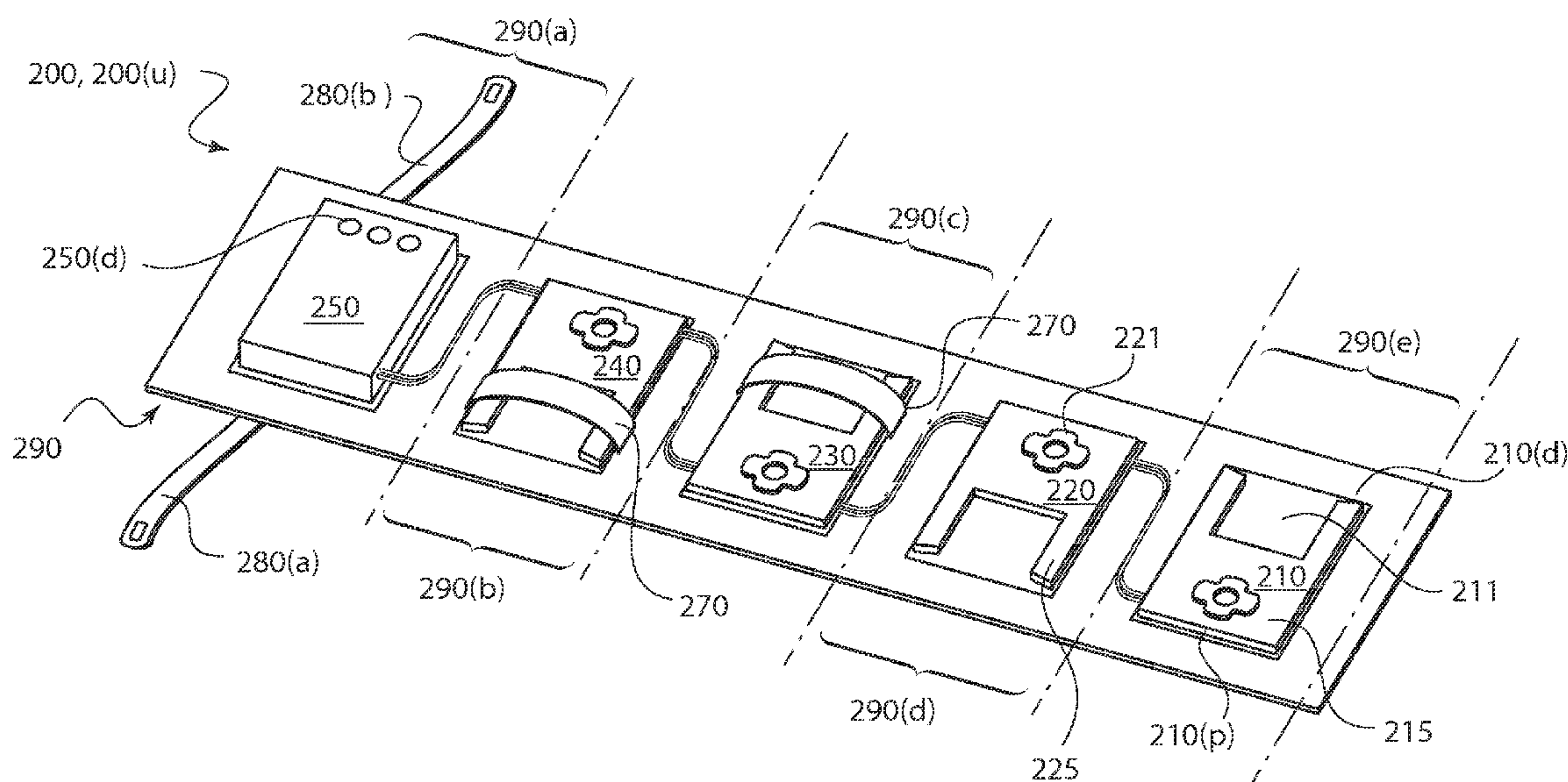
*Primary Examiner* — Suchin Parihar

(74) *Attorney, Agent, or Firm* — Keusey & Associates, P.C.

(57) **ABSTRACT**

An adapter for a portable battery charging apparatus having two or more battery charging interfaces on separate panels. Wires electrically couple the battery charging apparatuses to a charger unit. The wires are routed for flexibility to fold and unfold the panels. The adapter is configured to nest between two panels of the battery charging apparatus when the panels are stacked together in a compact folded state.

**20 Claims, 7 Drawing Sheets**



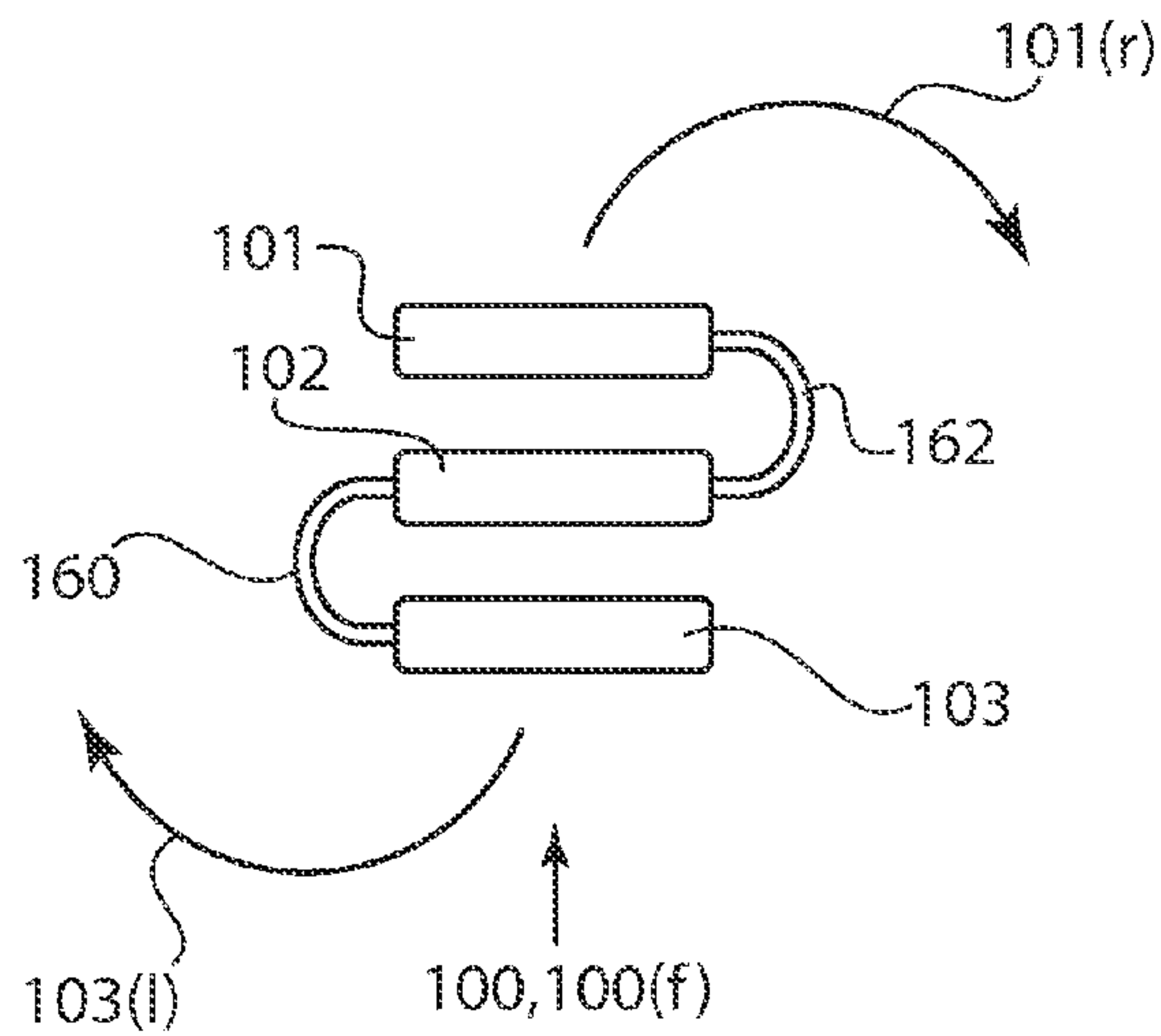


FIG. 1A

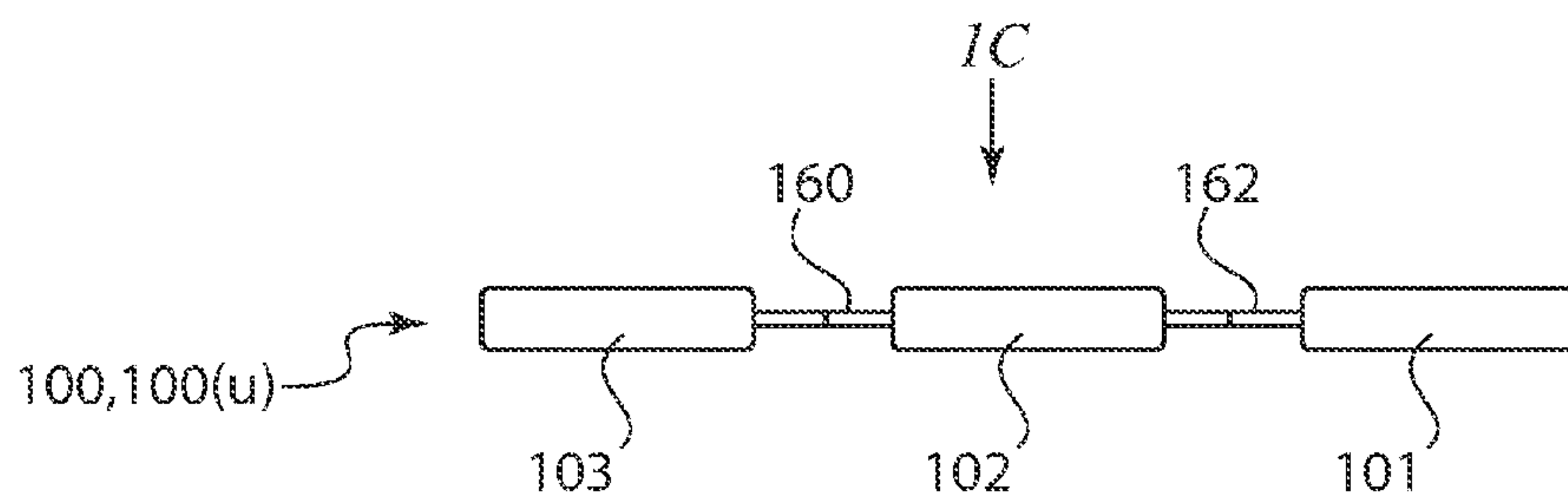


FIG. 1B

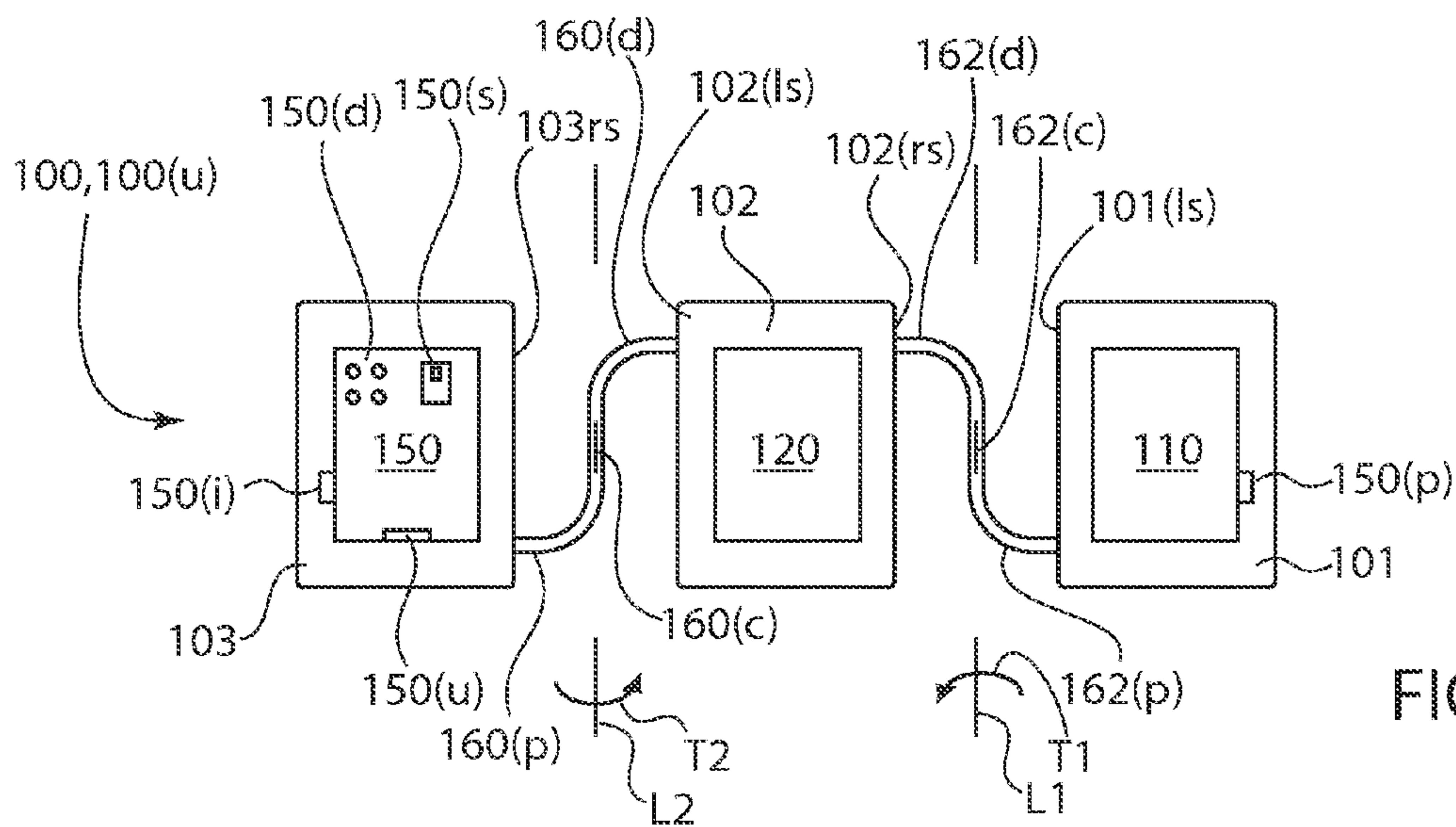


FIG. 1C

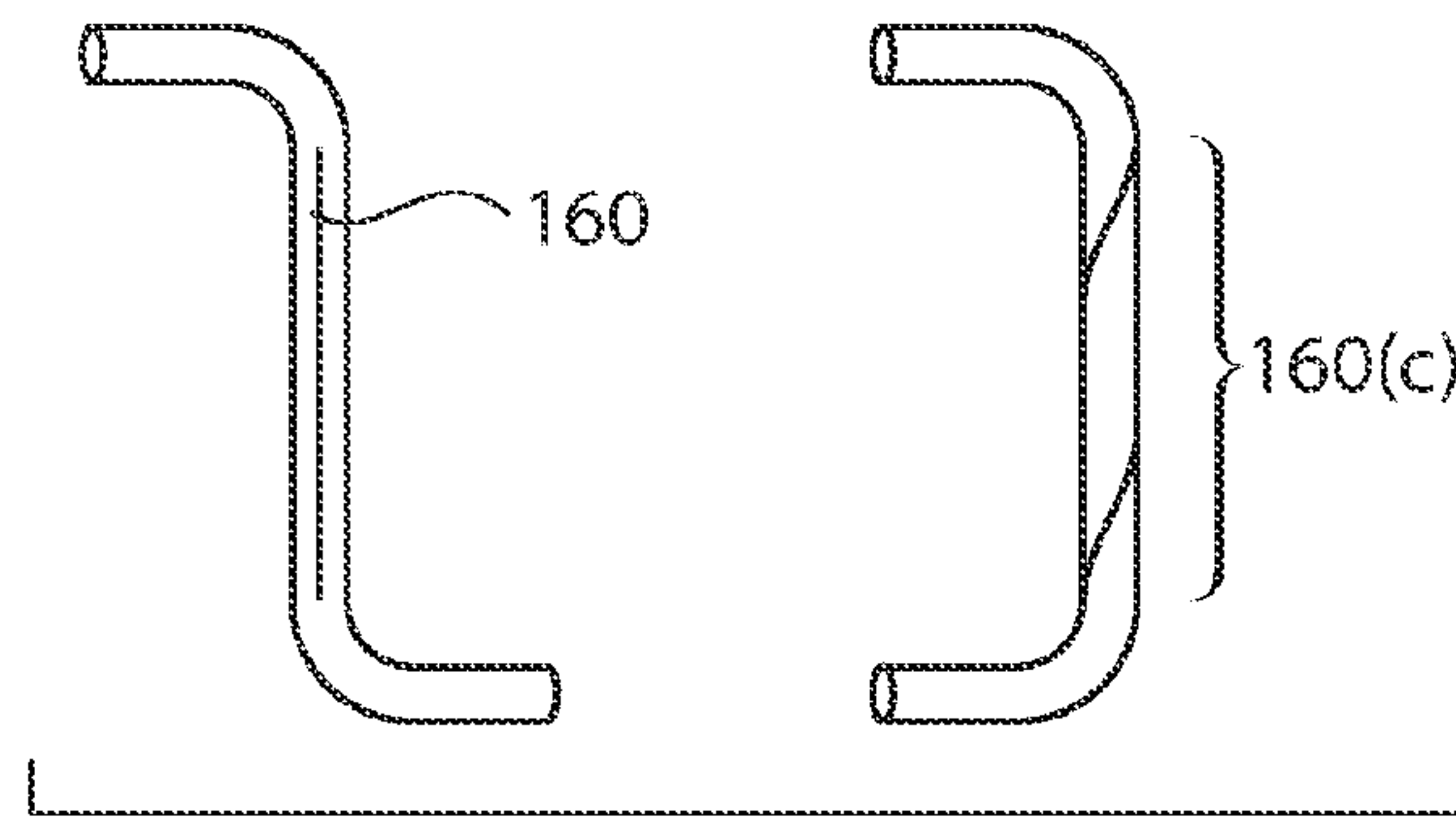


FIG. 1D

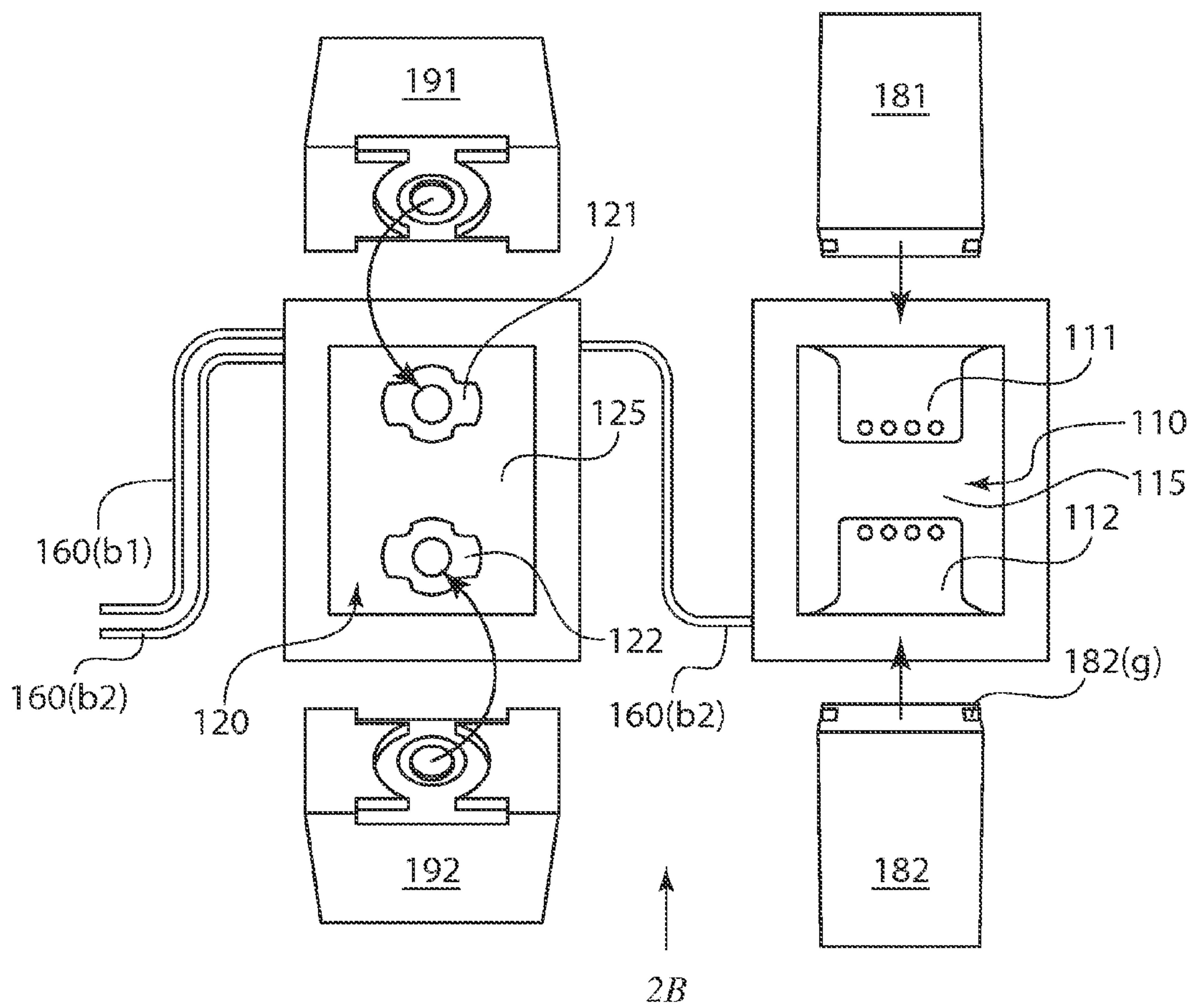


FIG. 2A

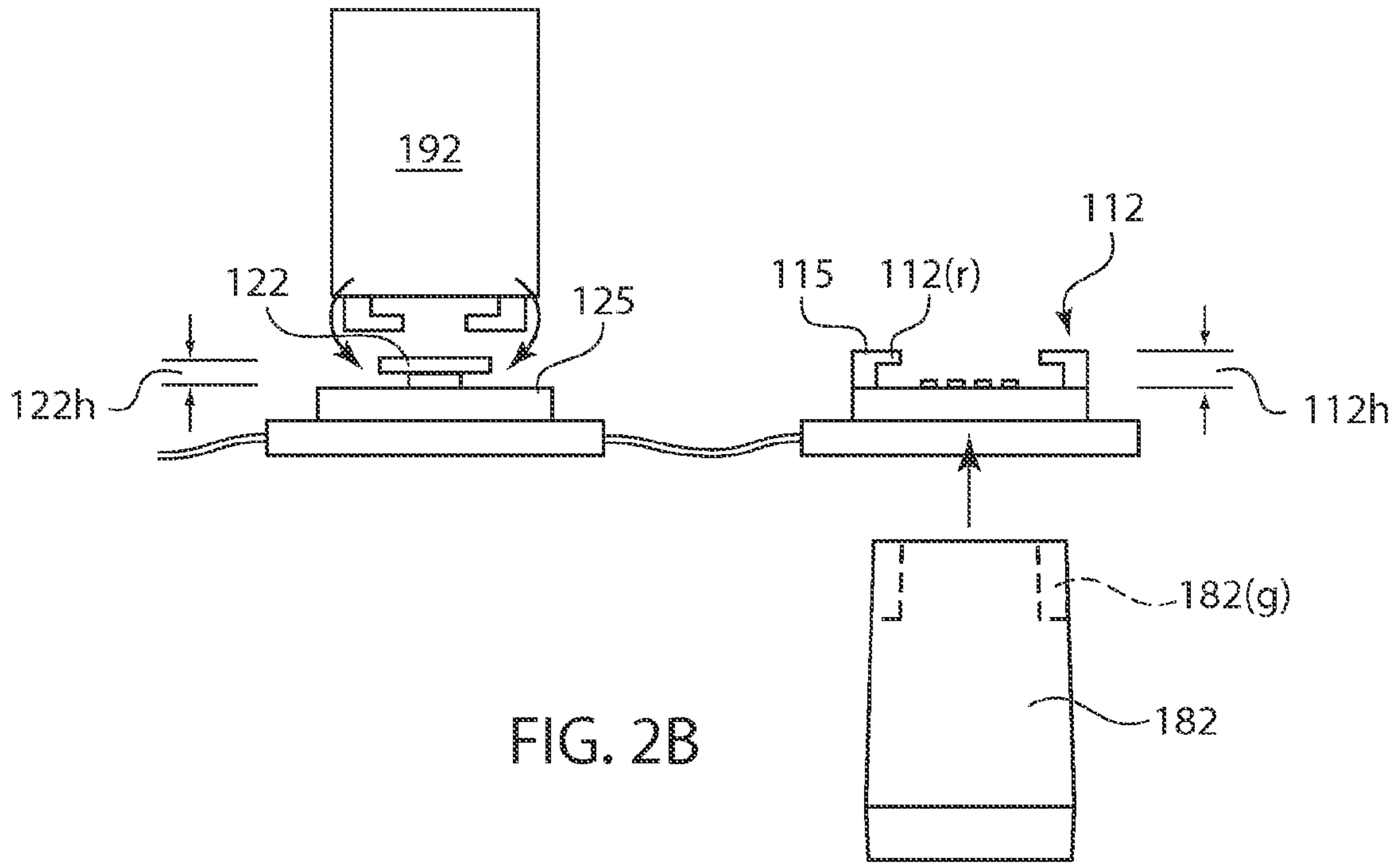


FIG. 2B

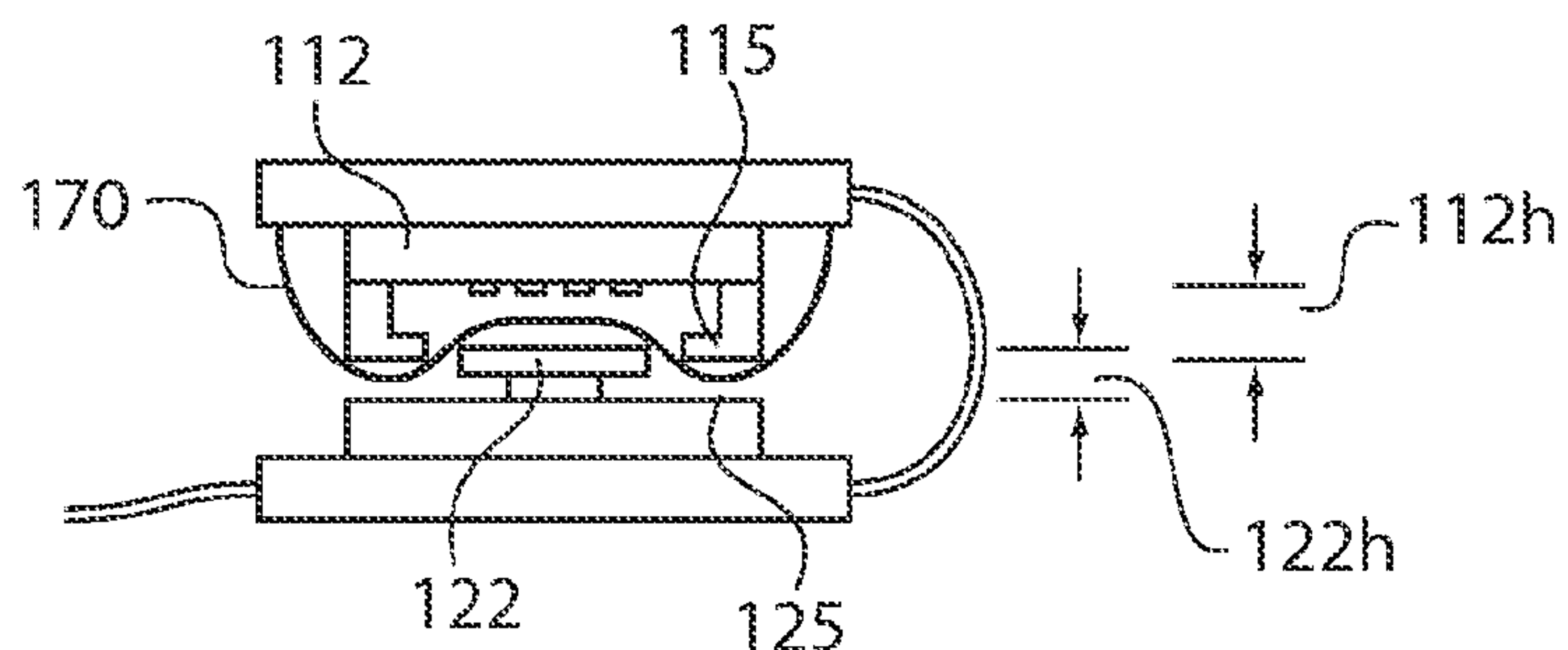


FIG. 2C



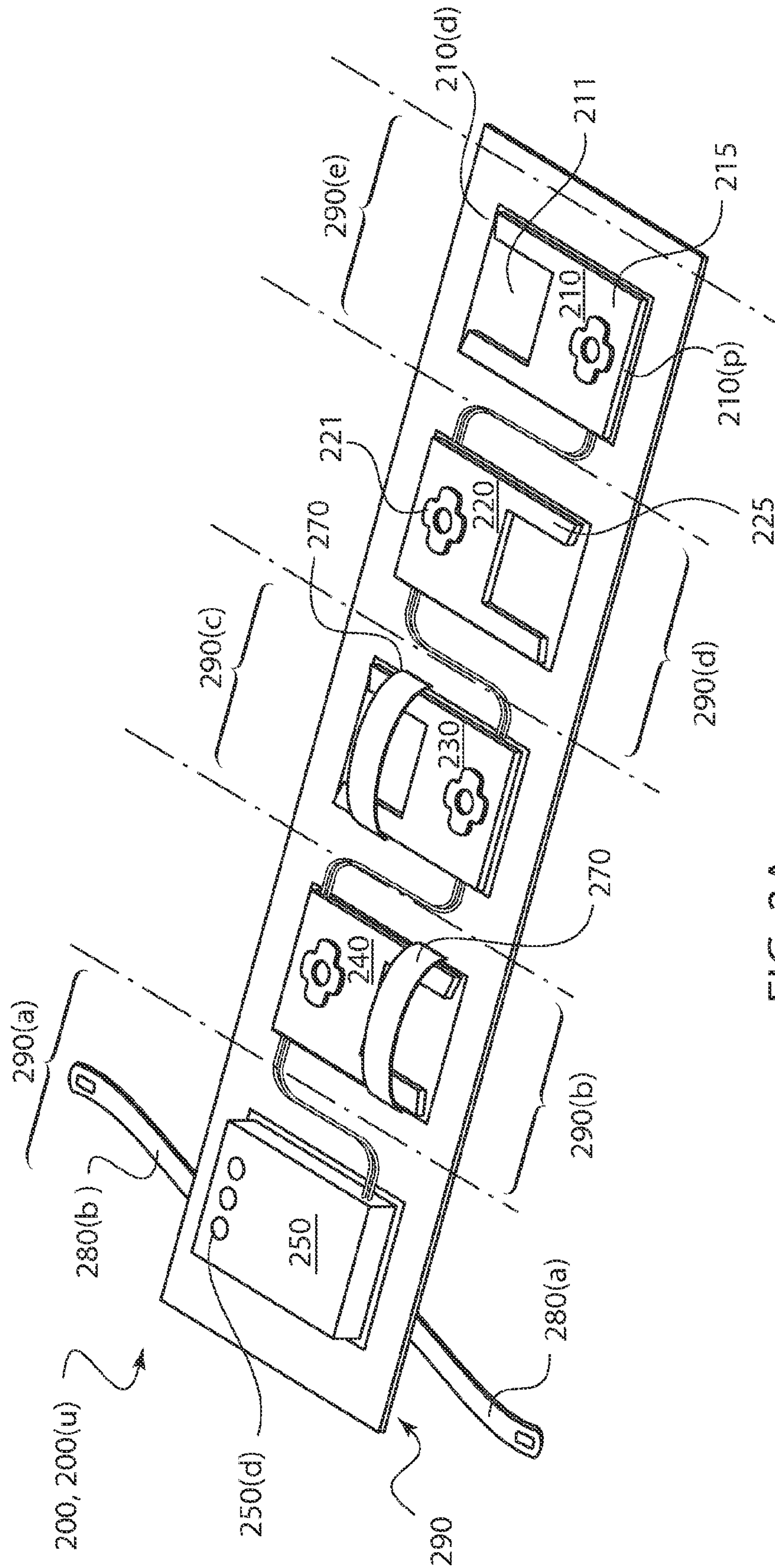


FIG. 3A

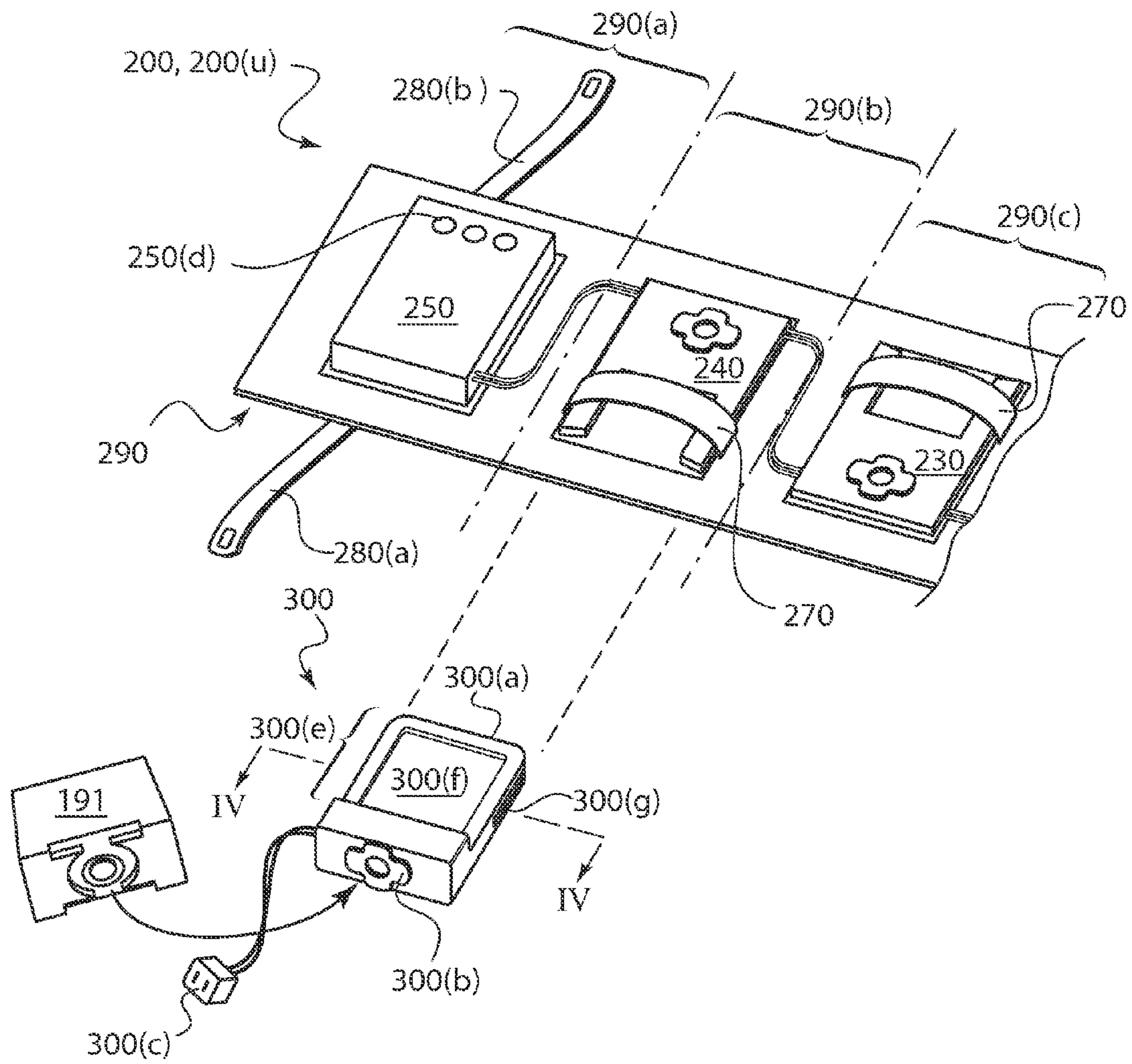


FIG. 3B

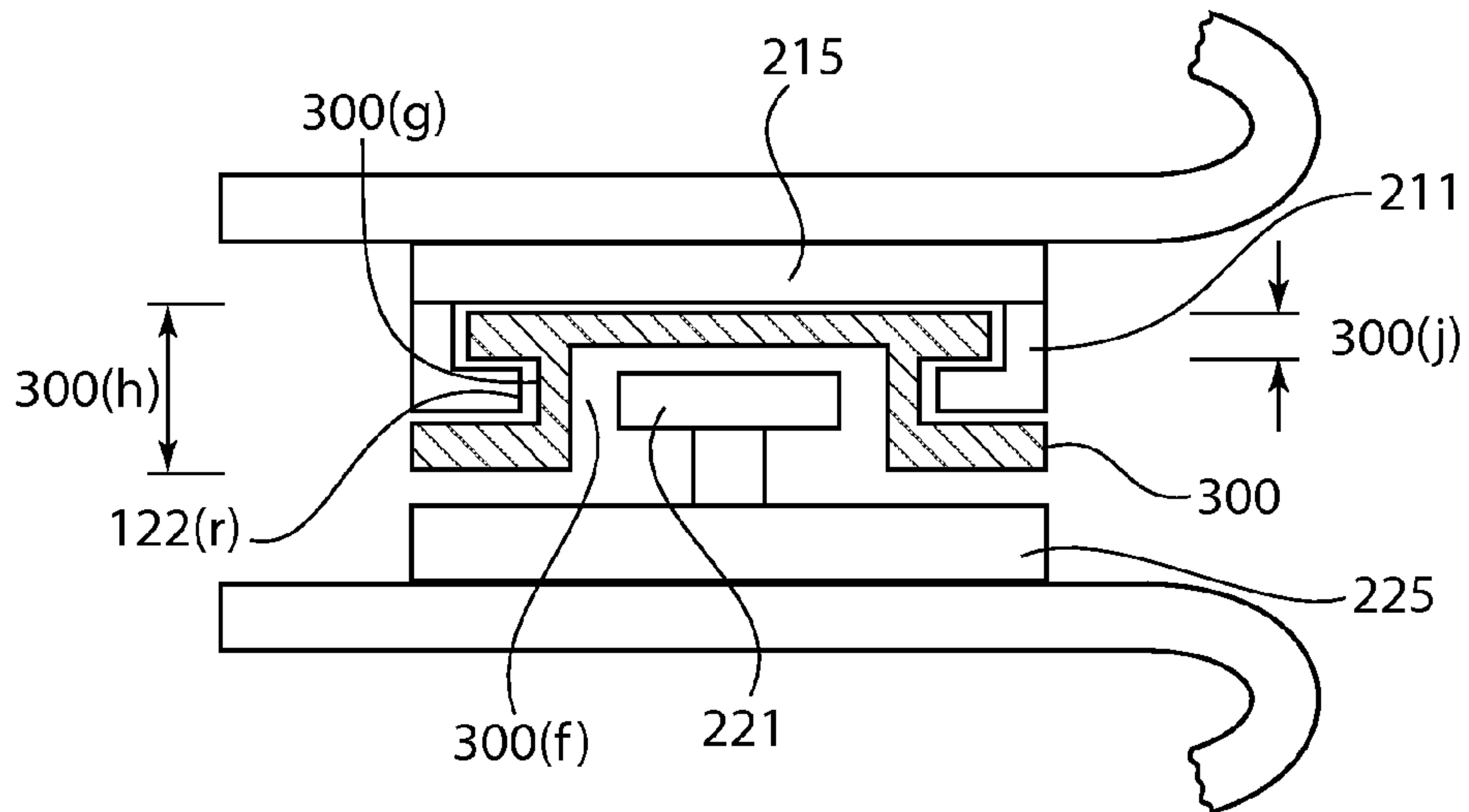


FIG. 4

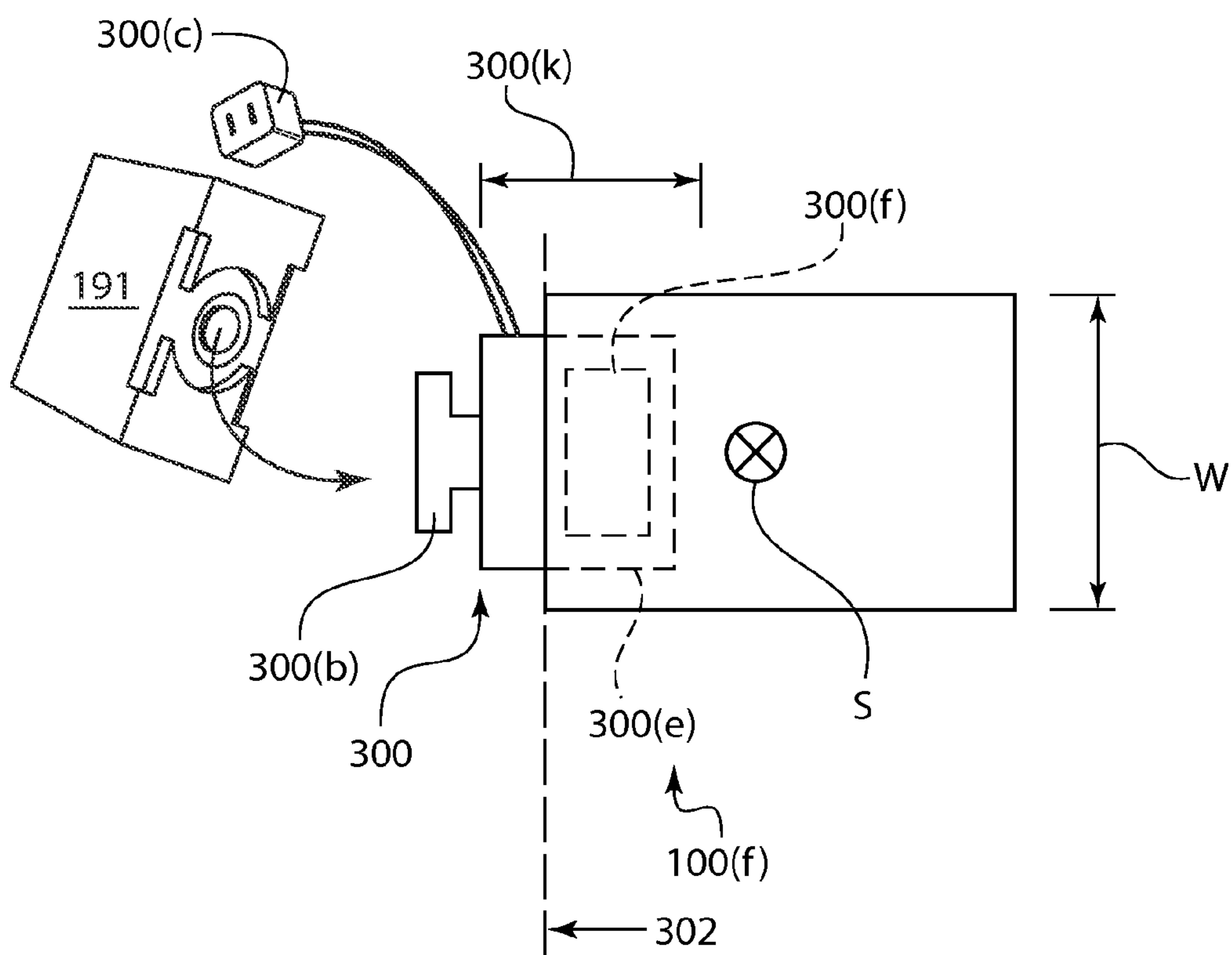


FIG. 5

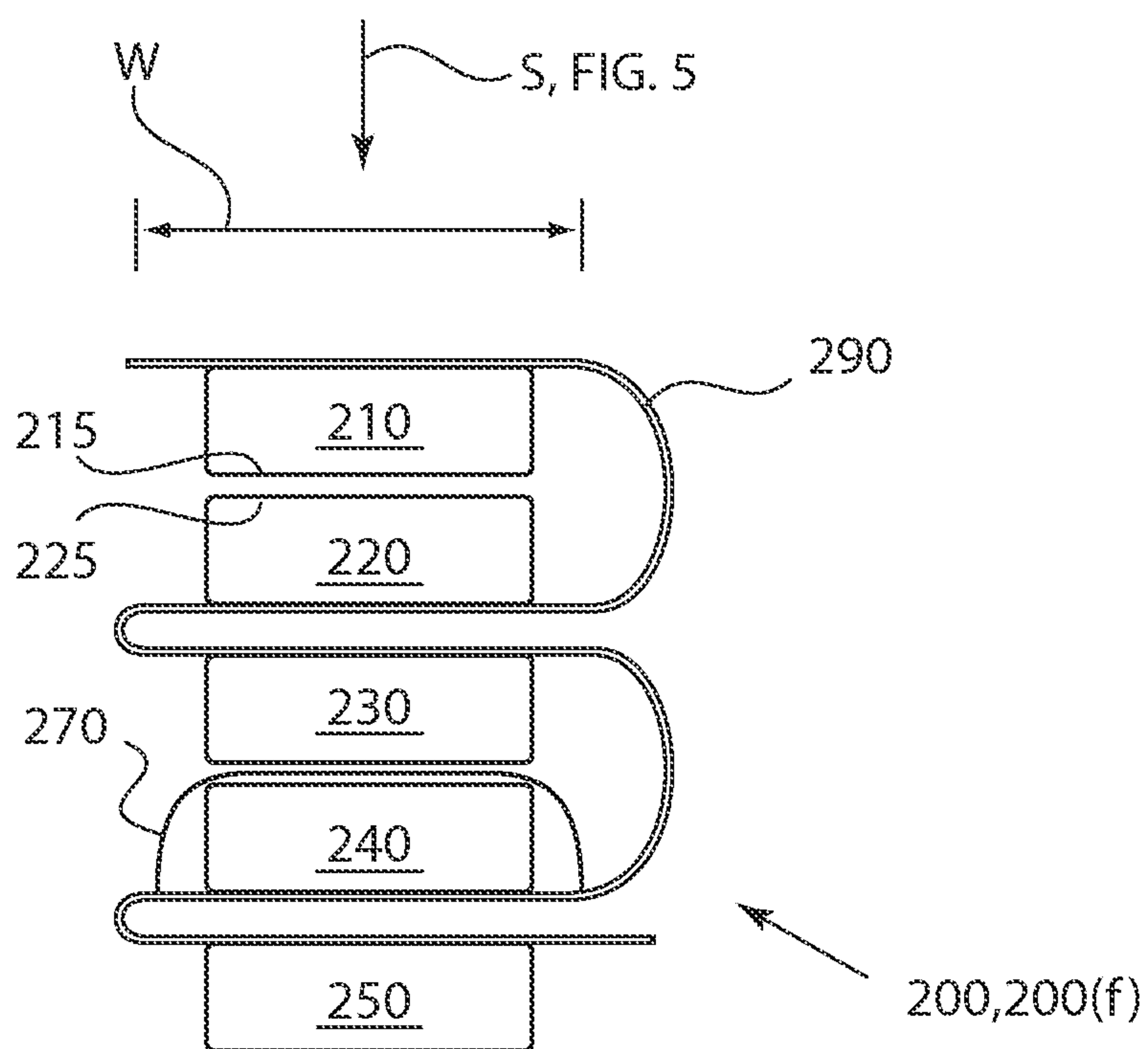


FIG. 6



## ADAPTER FOR FOLDABLE BATTERY CHARGER

### CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Continuation-In-Part Application of co-pending U.S. patent application Ser. No. 13/927,447 filed on Jun. 26, 2013 which application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/664,868 filed Jun. 27, 2012.

### BACKGROUND OF THE INVENTION

#### 1. Technical Field

The invention relates to an adapter for a foldable battery charger.

#### 2. Description of the Related Art

Battery chargers are relatively large, bulky pieces of equipment. They typically have a rigid housing which can be moved but is difficult to transport by foot because of the weight and volume they occupy. Persons working in the field and military personnel have a need to carry battery chargers with them.

Some foldable equipment having batteries or chargers has been proposed in the prior art U.S. Pat. No. 3,919,615 discloses a flexible belt with a charger and batteries for a video camera. The power belt has a dedicated charging unit which can only charge one type of battery. The battery packs do not include hinges between them to allow the packs to stack on top of each other.

U.S. Published Patent Application No. 2005/0052156 shows a charging mat having an embedded control switching circuit. The charging mat does not include wires that connect discrete battery charging interfaces to allow stacking. The charging mat does not include charging jacks of different types which nest together in a mating fashion. In addition, there is no disclosure of an adapter to mount different batteries, where the adapter can nest between panels in a folded state.

U.S. Pat. No. 5,295,089 discloses a flexible sheet material having embedded cables to couple various electronic devices. The device uses flat cables 46, 56, and 64, which has been shown to prematurely fail when bent repeatedly.

U.S. Pat. No. 5,601,942 shows a battery pack with foldable panels, attached batteries and a charger. The battery pack does not include an on-board charging unit or adapter that can nest between panels in a folded compact state.

None of the references show an adapter to connect batteries outboard of the panels or mat, where the adapter is able to nest between two panels of a portable battery charger when the panels are stacked together in a compact folded state.

### SUMMARY OF THE INVENTION

Accordingly, it is an object of an embodiment of the invention to provide an adapter and charger for different types of batteries that can be packed into a small size for portability.

It is another object is to provide an adapter can be stored in a mating configuration to save space.

It is a further object to dimension the body of the adapter to allow charging of batteries outboard of the panels or mat.

It is another object to provide e adapter with a cable or fixed terminals for coup mg to various types of batteries.

These and other related objects are achieved according to the invention by a portable battery charging apparatus having two or more battery charging interfaces. A first and a second

battery charging interface define a first and second panel respectively. A charger unit defines a third panel. Electrical wires operatively couple the charger unit to the battery charging interfaces. The wires have hinge-like flexibility to allow the panels to be configurable between two states. The first state comprises a compact folded state in which all three panels are stacked on top of each other thereby conserving space during transport. The second state comprises an unfolded, operational state in which at least the first and second panels are arranged side-by-side thereby providing clearance to insert batteries into said first and second battery charging interfaces. An adapter is configured to couple to one of the battery charging interfaces in the compact folded state.

Adjacent panels have sides which meet each other along a hinge axis that extends in a longitudinal direction. The electrical wires have a central section that extends generally parallel to the hinge axis. The central section is twisted when the adjacent panels are pivoted between the two states. The electrical wires have a distal section and a proximal section, which extend generally perpendicularly from the central section in opposite directions from each other. In the unfolded state, the wires have an S- or Z-shape. In the folded state, they have a C-shape.

The charging unit includes an input for receiving power from an upstream device, an output for powering a downstream device, and means for selectively powering each of said battery charging interfaces. Each battery charging interface includes two or more individual charging stations. Each battery charging interface includes a distal and a proximal end. A first charging station is located at the distal end; and a second charging station, different from the first charging station, is located at the proximal end. The adapter couples to one of the charging stations to provide a differently configured charging station. The electrical wires have multiple conductors that are divided into a first electrical bus for the first charging stations and a second electrical bus for the second charging stations.

The charger unit includes means for identifying different battery types when connected to the first charging station, the second charging station, or the adapter and means for selectively and independently powering each connected battery. Two or more portable battery charging apparatuses can be daisy chained together to share a common power source. The charger unit includes battery status indicators and a control to shut off the indicators. Each battery charging interface includes a circuit to identify at least one of battery presence, battery state-of-charge, and recharge status; and wherein information is transmitted between the circuit and the charger unit.

The first battery charging interface has a raised charging station at the distal end and a depressed charging station at the proximal end. The second battery charging interface has a depressed charging station at the distal end and a raised charging station at the proximal end. The first battery charging interface and the second battery charging interface face each other in the compact, folded state. The adapter is sandwiched between the first and second battery charging interfaces. In the compact, folded state the two raised charging stations fit within the two depressed charging stations. The adapter has a low-profile housing disposed between one of the raised charging stations and one of the depressed charging stations. Each battery charging interface includes an insulating pad that resides between the raised charging station and the corresponding fitted depressed charging station in the compact, folded state to prevent short circuits between the charging stations. The adapter is located between the insulating panel and one of the charging stations.



3

To increase the protection and durability of the charger, the charger may include a foldable mat that has the charger unit and the battery charging interfaces mounted on it. The mat is made of a flexible material, a waterproof material, nylon material, canvas material, a synthetic material, or a thermo-plastic material. A strap is connected to the mat to secure the panels together in the folded state. The apparatus may include one or more battery charging interfaces defining a fourth or more panels. The mat may include regions that correspond to the panels. Regions can be arranged in a row, in an L-shape, a T-shape, or other configuration. The key feature is that the panels can be folded to stack on top of each other. This stack conserves space and protects the components which are internal of the stack.

The charger unit includes a circuit to identify at least one of adapter presence, battery presence, battery type, battery, state-of-charge and recharge status. The charger unit includes a portable device charging jack, for example a USB jack. If an external power source is not available, the USB jack may be powered by a battery coupled to one of the battery charging interfaces or the adapter.

In an alternate embodiment, there is provided an adapter for modifying a battery charging station on a portable battery charger. The adapter has a low-profile housing including an input connection and an output connection of a different type. The input connection is adapted to electrically couple, and re-movably mechanically attach, to a battery charging station of first type located on a panel of a portable, foldable battery charger. The low-profile housing is adapted and configured to nest between two panels of a portable battery charger when the panels are stacked in a compact folded state.

The low-profile housing includes a centrally-located depression, or well, that is dimensioned and positioned to receive a raised charging station located on a facing panel of a portable battery charger. The housing includes an elongated body that spaces the output connection from the input connection. The body is dimensioned, and elongated sufficiently, to locate the output connection outboard of the panels of a portable battery charger. Alternatively, the body is dimensioned, and elongated sufficiently, to locate the output connection outboard of a mat which supports the panels of a portable battery charger.

The output connection is a fixed battery charging station for coupling to a battery having a different interface than the input connection. Alternatively, for large batteries, the output connection is a cable extending from the adapter having a battery charging jack or jacks on its end to connect to a battery having a different interface than the input connection.

#### BRIEF DESCRIPTION OF DRAWINGS

The advantages, nature, and various additional features of the invention will appear more fully upon consideration of the illustrative embodiments now to be described in detail in connection with accompanying drawings. In the drawings like reference numerals denote similar components throughout the views:

FIG. 1A is front side elevational schematic view of a battery charging apparatus according to an embodiment of the invention.

FIG. 1B is a further schematic view of the battery charging apparatus in an unfolded state.

FIG. 1C is a top plan schematic view thereof.

FIG. 1D is a schematic view of wire twisting movement between folded and unfolded states.

FIG. 2A is a top plan view showing details of the battery charging interfaces.

4

FIG. 2B is a front side elevational view thereof.

FIG. 2C is a further front view of the battery charging apparatus in the folded state.

FIG. 3A is a perspective view of a battery charging device according to a further embodiment of the invention.

FIG. 3B is a perspective view of an adapter and a battery charging device.

FIG. 4 is a cross-sectional view of the folded battery charging device, taken along the line IV-IV through the adapter.

FIG. 5 is a top plan view of the battery charging device in the compact, folded state with the adapter installed.

FIG. 6 is a front side elevational schematic view of the battery charging device in the compact, folded state.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

These and other objects, features, and advantages of the present invention will become apparent from the following detailed description of illustrative embodiments thereof, which is to be read in connection with the accompanying drawings.

Referring now in detail to the drawings, and in particular to FIGS. 1A, 1B and 1C, there is shown a battery charging apparatus **100** according to an embodiment of the invention. The battery charging apparatus includes two or more battery charging interfaces, a charger unit, and electrical connections therebetween. In a first embodiment, a first battery charging interface **110**, a second battery charging interface **120**, and a charger unit **150** are shown. Electrical wires **160** connect from the charger unit **150** to said second battery charging interface, and wires **162** connect from said second battery charging interface to first battery charging interface **110**. Charging unit **150** is shown on the left of the battery charging interfaces. However, charging unit could be located between the battery charging interfaces, to the right of the interfaces, above or below the interfaces, or beneath the interfaces. The charging unit could be incorporated into an interface.

For the various configuration structures in one embodiment, the first battery charging interface is defined as a first panel **101**, the second battery charging interface is defined as a second panel **102**, and the charger unit **150** is defined as a third panel **103**. FIG. 1A shows a folded state **100(f)** wherein panels **101**, **102**, and **103** are stacked on top of each other to conserve space and protect the components during storage and transport. Panel **101** can be pivoted to the right, as indicated by arrow **101(r)**, to unfold the first battery charging interface. FIG. 1B shows a front view in the unfolded state **100(u)** wherein panels **101** and **102** are arranged side-by-side to provide clearance to insert batteries into the battery charging interfaces. Panel **103** could be located between panels **101** and **102** or in any other location where it would avoid interference with battery insertion. From the location of FIG. 1A, panel **103** can be pivoted left, as indicated by arrow **103(l)**, to unfold the charger unit.

FIG. 1C shows a top plan view in the unfolded state **100(u)**. Each panel has a right side (rs) and a left side (ls). The right side **102(rs)** of panel **102** meets the left side **101(ls)** of panel **101** along a hinge axis that extends in a longitudinal direction **L1**. Electrical wires **162** have a central section **162(c)** that extends generally parallel to the hinge axis. The electrical wires are routed in an S-shape between adjacent panels to provide a length of wire that can twist **T1** about 180 degrees. In other words, central section **162(s)** stays linear and allows the panels to pivot without inducing kinking or folding in the wire. When panel **101** is unfolded in direction **101(r)**, central section **162(s)** twists in a direction opposite **T1**. The electrical



## 5

wire includes a distal section **162(d)** and a proximal section **162(p)** that extend perpendicular to the central section **162(s)** in opposite directions to make the connections to the interfaces.

FIG. 1D shows the electrical wire **160** movement in greater detail. The left side of FIG. 1D shows electrical wire **160** in an S- or Z-shape when the battery charging apparatus **100** is in the unfolded state **100(u)**. A thin line extends down the central section of connecting wire **160** for illustrative purposes. When two panels **101**, **102** are folded on top of each other, the central section **160(c)** of the wire twists into a C-shape. The thin line is now shown in the right side of FIG. 1D as wrapping around the wire like a helical candy cart strip. When the panels are unfolded, the wire returns to the S-shape. The wire is selected for suitable gauge, number of conductors, stranded or solid, and length to withstand repeated twisting and untwisting. The electrical wires may also be referred to as a multi-conductor cable. As will be appreciated, the twisting of the wire along a longitudinal section thereof prevents the wire from kinking or folding at one point thereby extending its useful life.

The electrical wire **160** also includes a distal section **160(d)**, a central section **160(c)** generally parallel to the hinge axis extending in the longitudinal direction **L2** for twisting in direction **T2**, and a proximal section **160(p)**. Electrical wire is shown between right side **103(rs)** and left side **102(ls)** of adjacent panels. Alternatively, the electrical wire **160** could connect panel **103** to the front, back, or bottom of the other panels. In a similar way, additional panels could be added to the apparatus to provide additional interfaces or other electronic devices. Charger unit **150** includes an input **150(i)**, which is adapted to receive power from an upstream external power supply. The power supply can be an AC mains, vehicle power, solar panel, bank of batteries, generator, or any other suitable fixed or portable power source. The charger unit also includes an output **150(p)** that can provide power to a downstream device, for example, a further battery charging apparatus **100**. While the input **150(i)** is shown mounted on the charger unit **150**, it can be placed in any location on the foldable battery charger with cables routing power to the charger unit **150**. While the output **150(p)** power jack is shown mounted on panel **103**, it can be placed in any location on the foldable battery charger.

Standard power jacks may be incorporated into charger unit **150**, for example, a USB jack **150(u)** to provide power to recharge devices. Accordingly, a cell phone or tablet could be plugged into USB jack **150(u)** to draw power while the larger batteries are being recharged in the battery charging interfaces. If external power is not available, one of the connected batteries may power the USB jack. Charger unit **150** may include one or several charge status displays **150(d)**, for example, lighted indicators, LED, or liquid crystal display. The lighted indicator(s) may be multi-color or multi-state (flashing, solid). A switch **150(s)** is provided to turn off all lighted indicators if a black-out condition is desired. In the embodiment of FIG. 1C, one colored LED can be provided for the status of each battery charging interface. For example, the LED will illuminate: Red if the battery connected to battery charging interface **110** is low on power; yellow to indicate the battery is charging; and green if the battery is completely charged. Alternatively, a set of red, yellow, and green LEDs may be provided for each battery charging interface.

The central section **162(c)** of wire **162** is shown as the hinge structure. The hinge structure could also include a fabric strap, flexible material mat, or a conventional hinge, like a metal piano hinge or a plastic door hinge. The hinge

## 6

parts could be extensions of the interfaces or panels. The hinge parts could be formed from a separate layer of material onto which the panels or interfaces are attached, as will be described in greater detail below.

Each battery charging interface can be provided with 1, 2, or more individual charging jacks. In this application, a charging jack means a device or adapter configured and powered to recharge a single battery. FIG. 2A shows two charging jacks **111**, **112** of a first type disposed on the first battery charging interface **110**. The charging jacks include four round contacts, namely, two contacts for transmitting power and two additional contacts for receiving data about the battery's state, e.g., state of charge. The charging jack illustrated includes guide rails **112(r)**. The corresponding battery charging connector has two power and two data contacts. The housing of battery **182** includes grooves **182(g)** that slide along the rail **112(r)** to hold the battery charging connector in a fixed position to ensure a good connection.

Battery charging interface **120** includes two charging jacks **121**, **122** of the same type, each with concentric contacts for transmitting power and receiving data. The top plan view of FIG. 2A shows batteries **181** and **182** that can slide along the plane of the page into charging jacks **111**, **112**. It will be understood by those skilled in the art that the configuration of the charging jacks is similar to the configuration of the device that is powered by the battery. The front elevational view of FIG. 2B shows batteries **191** and **192** that can drop vertically and twist mount onto charging jacks **121**, **122**. Charging jacks **121**, **122** are cross-shaped discs that are installed on a platform so that they sit slightly raised off the surface of the deck **125**. FIG. 2B also shows charging jack **122** being a protruding jack extending a height **122(h)** above the deck **125** of the battery charging interface **120**. Charging jack **112** is a depressed jack retracting in height **112(h)** below the deck **115** of the battery charging interface **110**.

FIG. 2C illustrates the folded state wherein the decks **115**, **125** of battery charging interfaces **110**, **120** are stacked together. The placement of the jacks **112** and **120** is arranged so that the protruding jack **122** can fit within the depression of the recessed jack **112** when the battery charging interfaces are folded. The height **112(h)** of the depression of jack **112** is greater than the height **122(h)** of the protruding jack **122**. This allows the charging jacks to fully mate so that decks **115** and **125** will come into contact with each other thereby minimizing the volume of the folded battery charger. A non-conductive pad **170** may be provided as an insulating layer between jacks **112** and **122** to prevent short circuits between the jacks. In one embodiment, the insulating pad **170** comprises a fabric strap that is loosely connected across jacks **111**, **112**. The loose connection ensures that batteries **181**, **182** have room to slide beneath the strap. A similar arrangement with the jack height, deck contact, and insulating layer is provided for jacks **111** and **121**.

FIG. 3A shows an alternate embodiment of a battery charging apparatus **200** having a foldable mat **290** divided into regions **290(a)**, **290(b)**, **290(c)**, **290(d)**, and **290(e)**. The regions may serve as the panels. The mat **290** can be made of a flexible, preferably waterproof material, for example, nylon or canvas. The charger unit **250** is secured to the first region. Each of the other regions has one battery charging interface **210**, **220**, **230** or **240** secured to it. Of course, a fewer or greater number of regions may be provided. The charger unit may be located in any of the regions. While the regions are shown arranged linearly, they may be alternately be disposed in a T-shape, L-shape, cross shape, or other suitable arrangement. Each region may contain one or more charging jacks, with the charging jacks being freely selected to recharge any



type of battery. Due to the flexible nature of the mat **290**, one region can be folded to overlie the adjacent region. Consider two or more panels or regions each having a width  $W$ . The mat **200** in FIG. **3A** would have an overall width of  $SW$  in the unfolded state **200(u)**. FIG. **5** shows the stack  $S$  wherein the regions or panels are overlying each other, i.e., the folded state **200(f)**. The overall width of the stack is  $W$ , with the regions or panels forming a series of planes that are disposed parallel to each other. In the unfolded state **200(u)**, the regions or panels are re-oriented to be co-planar. In the field, the mat **200** can be laid out to provide a clean, dry surface to insert batteries into the charging jacks.

The protruding charging jacks **221** are connected to a first bus, while the depressed charging jacks **211** are connected to a second bus. Accordingly, the charger unit views the eight charging jacks as two separate groups, each with its own type of charging jack. As batteries are installed, they communicate state-of-charge and other battery data to the charging unit. As additional batteries are installed on the same bus, charging unit assesses the relative state-of-charge between the batteries and implements an appropriate recharging strategy. For example, batteries with the lowest state-of-charge may be charged first. Other batteries on the same bus may not receive a charge until the lowest battery reaches a predetermined level of charge. The battery charging interface **210**, **220**, **230**, **240** may include part of the charger unit circuitry to identify the presence of a battery, identify battery type, and identify state-of-charge. This information will be communicated along the data channels of the bus to the charger unit, which can then implement a charging strategy and illuminate the appropriate charge status displays **250(d)**. In the embodiment of FIG. **3A**, charger unit **250** may be provided with eight multi-color LED lights, one for each of the eight charging jacks.

Battery charging interface **210** is shown with a depressed charging jack **211** at the distal end **210(d)** of the battery charging interface **210** on region **290(e)**. A protruding charging jack **221** is then located at the distal end of the battery charging interface **220** on region **290(d)**. In other words, each battery charging interface can include charging jacks of different types.

FIG. **3B** shows one embodiment of an adapter **300**. In the illustrated example, the battery charging apparatus **200** needs an additional jack of the type identified by protruding charging jack **221**. Adapter **300** includes an input connection **300a** that will electrically couple with the contacts on depressed charging jack **211**. Adapter **300** has grooves **300g** that will mechanically engage charging jack **211**, by sliding along the rails **112(r)** of the charging jack. Adapter **300** includes contacts and grooves to engage charging jack **211** in a manner similar to battery **182** and its grooves **182(g)**. Adapter **300** includes a fixed output connection **300b**, similar to charging jack **221**, for connecting to a battery **192**. The battery charging apparatus **200** with battery charging interfaces **230** and **240** provides two protruding charging jacks **221**. With the addition of two adapters **300**, the battery charging apparatus would be equipped with four protruding charging jacks, namely the two protruding charging jacks **221** and two fixed output connections **300b**. Alternatively, or in addition, adapter **300** includes a flexible cable that terminates in an output connection **300(c)**. The flexible cable can be used to charge a large battery by bringing the battery charging apparatus **200** near the large battery and coupling the output connection **300(c)** to the large battery contacts via the flexible cable.

Referring now to FIGS. **3B**, **4** and **5**, adapter **300** includes a low-profile housing **300(e)** characterized by a depression **300(f)** that resides within depressed charging jack **211** and

accommodates protruding charging jack **221**, when the battery charging apparatus is in the compact, folded state. FIG. **4** shows adapter **300** in cross-section with the battery charging apparatus folded. Rails **112(r)** are disposed within grooves **300(g)** to mechanically attach adapter **300** to the depressed charging jack **211**. The overall height **300(h)** of adapter **300** and the depression height **300(j)** are dimensioned so that protruding charger **221** can nest within depressed charging jack **211** in the same manner as if adapter **300** was not present. In other words, the presence of the adapter does not interfere with the battery charging apparatus transitioning between the open and folded states.

FIG. **5** shows the length **300(k)** of housing **300(e)** which is dimensioned to locate the output connection **300(b)** outboard of the battery charging interfaces and mat. The vertical dotted line represents the lower edge of the battery charging interfaces, or mat, with arrow **302** indicating the portion of adapter **300** that extends outboard thereof. Charging unit **250** can recognize the type and status of a battery, or batteries, coupled to the adapter. Each battery charging interface includes a circuit to identify at least one of adapter presence, battery presence, battery type, battery state-of-charge, and recharge status, which information is transmitted between the circuit and the charger unit.

FIG. **6** shows the mat **290** folded four times to bring all five regions into a stack. This is equivalent to stacking the panels on top of each other. In this folded state, the protruding jacks on battery charging interface **210** fit within the depressed jacks of battery charging interface **220**. By staggering the placement of protruding and depressed jacks, each protruding jack will have a corresponding depressed jack to fit into when the mat is folded. FIG. **6** shows how deck **215** will lie flat against deck **225**. The compactness of the stack can be maintained even with adapter **300** plugged in due to the structural configuration and dimensions of its low-profile housing. Straps **280(a)** having a hook fastener and strap **280(b)** having a loop fastener can wrap around the folded stack to keep it in the folded configuration until it is desired to deploy the battery charging apparatus.

Two or more panels each bearing a battery charging interface may be provided in a row, T-shape, L-shape, or other configuration. For example, a rectangular panel having a top side, a bottom side, and two sides may be provided with a hinge on one, two, three, or four of its sides. Several different charging jacks with imbedded circuitry can be replaced on, or added, to the battery charging interfaces.

Having described the preferred embodiments (which are intended to be illustrative and not limiting) for materials, configurations, and folding options, it is noted that modifications and variations can be made by persons skilled in the art in light of the above teachings. The hinge may be formed from the connecting wires, a mechanical hinge, or a flexible mat. The mat may be made from a variety of natural or synthetic materials which are sufficiently water resistant and durable for the intended applications. The panels can contain one or more charging jacks of the same or different type. An adapter couples to the charging jacks and provides an additional fixed or flexible charging jack, or both, of a different type. Charging jacks may be placed in offset configurations to facilitate compactness when the apparatus is in its compact, folded state. The adapter is sized and dimensioned to nest between the protruding charging jack and the depressed charging jack. It is, therefore, to be understood that changes may be made in the particular embodiments of the invention disclosed which are within the scope and spirit of the invention.



What is claimed is:

1. A portable battery charging apparatus comprising:  
a first and a second battery charging interface which define  
a first and second panel respectively, wherein said first  
battery charging interface includes a raised charging  
station and said second battery charging interface  
includes a depressed charging station;  
electrical wires operatively coupling said first and second  
battery charging interfaces and having hinge-like flex-  
ibility to allow the panels to be configurable between  
two states comprising (i) a compact folded state in which  
the first and second panels are stacked on top of each  
other with said raised charging station fitting within said  
depressed charging station thereby conserving space  
during transport, and (ii) an unfolded operational state in  
which said first and second panels are arranged side-by-  
side thereby providing clearance to insert batteries into  
said first and second battery charging interfaces; and  
an adapter configured to couple to one of said charging  
stations to provide a differently configured charging sta-  
tion and dimensioned with a low-profile housing to fit  
between said raised charging station and said depressed  
charging station in the compact folded state.
2. The apparatus of claim 1, wherein adjacent panels have  
sides which meet each other along a hinge axis that extends in  
a longitudinal direction, and wherein said electrical wires  
have a central section that extends generally parallel to the  
hinge axis, wherein said central section is twisted when the  
adjacent panels are pivoted between the two states.
3. The apparatus of claim 2, wherein said electrical wires  
have a distal section and a proximal section which extend  
generally perpendicularly from the central section in opposite  
directions from each other.
4. The apparatus of claim 3, wherein each battery charging  
interface includes:  
a distal and a proximal end;  
a first charging station at the distal end and a second charg-  
ing station at the proximal end.
5. The apparatus of claim 4, further comprising a charger  
unit defining a third panel and including means for identify-  
ing different battery types when connected to one of said first  
charging station, said second charging station, and said  
adapter and means for selectively and independently power-  
ing each connected battery.
6. The apparatus of claim 4, wherein  
said first battery charging interface has said raised charging  
station at the distal end and a depressed charging station  
at the proximal end; and  
said second battery charging interface has said depressed  
charging station at the distal end and a raised charging  
station at the proximal end.
7. The apparatus of claim 6, wherein said first battery  
charging interface and said second battery charging interface  
face each other in the compact folded state, wherein said  
adapter is sandwiched between said first and second battery  
charging interfaces.
8. The apparatus of claim 7, wherein in the compact folded  
state the two raised charging stations fit within the two  
depressed charging stations.
9. The apparatus of claim 8, wherein each battery charging  
interface includes an insulating pad that resides between the  
raised charging station and the corresponding fitted depressed  
charging station in the compact, folded state to prevent short

circuits between the charging stations, and wherein said  
adapter is disposed between said insulating pad and one of  
said charging stations.

10. The apparatus of claim 1, further including a foldable  
mat, wherein said battery charging interfaces are mounted to  
the mat, wherein said mat is made of a flexible material  
selected from the group consisting of a waterproof material,  
nylon material, canvas material, a synthetic material, and a  
thermoplastic material.

11. The apparatus of claim 1, further comprising one or  
more battery charging interfaces defining a fourth or more  
panels.

12. The apparatus of claim 5, wherein said charger unit  
includes battery status indicators and a control to shut off the  
indicators, and wherein each battery charging interface  
includes a circuit to identify at least one of adapter presence,  
battery presence, battery type, battery state-of-charge, and  
recharge status, and wherein information is transmitted  
between the circuit and the charger unit.

13. The apparatus of claim 5, wherein said charger unit  
includes one of a USB jack and a portable device charging  
jack, wherein said charger unit further includes a portable  
device charging circuit for powering one of the USB jack and  
portable device jack from a battery coupled to one of the  
battery charging interfaces and the adapter.

14. An adapter for modifying a battery charging station on  
a portable battery charger comprising:

an adapter having a low-profile housing including:

an input connection for electrically coupling to a battery  
charging station of a first type located on a panel of a  
portable battery charger; and

an output connection of a second type; and

said low-profile housing being dimensioned to nest  
between a raised charging jack on one panel and a  
depressed charging jack on a facing panel of a portable  
battery charger when the panels are stacked together in a  
compact folded state.

15. The adapter of claim 14, wherein said low-profile hous-  
ing includes a centrally-located, depression that is dimen-  
sioned and positioned to overlie the depressed charging jack  
and to receive the raised charging jack.

16. The adapter of claim 15, wherein said low-profile hous-  
ing includes an elongated body that spaces said output con-  
nection from said input connection, wherein said elongated  
body is dimensioned to locate said output connection out-  
board of the panels of a portable battery charger.

17. The adapter of claim 15, wherein said low-profile hous-  
ing includes an elongated body that spaces said output con-  
nection from said input connection, wherein said elongated  
body is dimensioned to locate said output connection out-  
board of a mat which supports the panels of a portable battery  
charger.

18. The adapter of claim 17, wherein said output connec-  
tion comprises a fixed battery charging station that is adapted  
and configured to couple to a battery having an interface  
different than said input connection.

19. The adapter of claim 17, wherein said output connec-  
tion comprises a cable terminating in a battery charging jack  
that is adapted and configured to couple to a battery having an  
interface different than said input connection.

20. The adapter of claim 14, wherein said adapter is con-  
figured to cooperate with a circuit to identify at least one of  
adapter presence, battery presence, battery type, battery state-  
of-charge, and recharge status.